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ABSTRACT

Students in four freshman composition classes participated in a study to discover if computer assisted instruction (CAI) could be designed, developed, and programed that would effectively stimulate students' inventive processes. A computer was programed with questions drawn from Aristotles' enthymeme topics. Students in the experimental sections were taught the keyboard characteristics of a computer terminal and participated in practice sessions that reviewed the invention program's directions, specifically the direct commands and the question-asking features. Posttest administration began a week after the practice sessions. Students in the experimental sections were told, "If you think it, type it"; while those in the control sections were instructed, "If you think it, write it down." Both groups were given 30 minutes to complete the test. The primary findings of the study were: (1) CAI could be programed that would encourage growth both in the number and sophistication of ideas; (2) questioning dialogues could help students articulate, refine, and preserve their ideas; (3) these dialogues could ignore content in favor of perspective and still help students begin writing; and (4) theories of creativity based on intersecting content and perspective were programable. (FL)

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STIMULATING RHETORICAL INVENTION IN ENGLISH COMPOSITION THROUGH COMPUTER-ASSISTED INSTRUCTION

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The Problem

The impulse for this research was to combine the renewed interest in teaching invention--the process of exploring a subject to discover ideas or arguments--with the developing technology of instructional computing. The pedagogical assumption beneath this impulse was that invention was often the one rhetorical idea English teachers used a bit recklessly in composition classrooms. One of the primary causes for a certain recklessness seemed to be in not providing the students with explicit methods of inquiry. And if the strategy was provided, the students did not have an opportunity to practice the method well enough to internalize it. Granted, a teacher cannot teach insight--what ultimately must be the student's own personal, quite private journey toward understanding. Also, obviously, composition instructors cannot predict what the students will discover. But are these sufficient reasons for neglecting invention? Hardly. First, composition teachers can prompt students to make discoveries. Second, they can provide systematic strategies or procedures and give the students practice in the inquiry process. Richard Young (1976) describes particular aspects of the invention process which can be taught:

> The procedures themselves can be taught, as can their use in conscious thought; but one cannot teach direct control of the imaginative act or the unanticipated outcome. What can be taught is not, however, trivial; no one would question the importance of careful thought in the composing process. Furthermore, the use of heuristic procedures can coax imagination and memory; the intuitive act is not absolutely beyond the writer's control; it can be nourished and encouraged. (pp. 1-2)

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Nourishing and encouraging intuitive acts as well as coaxing students' imaginations and memories are certainly activities whose implications reach far beyond the English composition classroom. Might a computer help encourage intuition and coax imagination?

Two Propositions

Half of this research attempted to investigate three explicit methods of inquiry, evaluating them for any differences among the inquiry performances of freshman composition students. The other half of the research grew partly out of the methodological difficulty of isolating and collecting each individual's actual thinking process and partly from a fascination with the emerging technology of computer-assisted instruction (CAI). To date, no rhetorical research had anticipated the certain advantages computers could provide while actively prompting human beings to inquire, to think, to explain, and to understand.

Three immediate advantages prompted the investigation. First, stimulating invention through CAI offered a unique setting for studying, collecting, and describing what ultimately was the most individual behavior in the entire composition process--the discovery and the first formulation of ideas. Second, well-conceived, computer-assisted invention could be a viable, supplementary tool for composition teachers to add to their pedagogical repertoire, for actually having to give individual instruction about every conceivable subject a student might write about in a semester would be mentally, if not physically, exhausting. Third, using CAI as the independent variable in a specific research design would not only strengthen the experimental control, but also allow further replication and

continued development. From these considerations then, the major question evolved: could supplementary, open-ended, computer-assisted instruction be designed, developed, and programmed which would effectively stimulate most individual's inventive process? Ultimately, the specific objective became to design, program, test, and evaluate three CAI modules for stimulating rhetorical invention within the freshman English composition setting.

The Heuristics

The primary reason for selecting the Aristotelian topics, the dramatistic pentad, and the tagmemic discovery method was their current popularity. Since Lauer's (1967) evaluations of current rhetorical theories for their comprehensiveness and their efficiency, the "neo-Aristotelian" theory, Burke's theory, and the tagmemic model have accumulated some evidence that they are among the most powerful heuristic methods. In fact, Lauer's scale rates them at ten, twelve, and fourteen "total power" scores respectively (pp. 145-149). The distinctions among the three fell beneath the two criteria of simplicity and sequence--Burke's pentad losing two points to tagmemics for simplicity; Aristotle's topics losing more legitimately four points to tagmemics for these categories. Still, such distinctions need to be verified, and other "operating" distinctions clarified and reported among these three systems. Needless to say, if this research prompts either other CAI-invention modules or evaluative research designs among heuristic methods, then it too has become a heuristic.

The CAI questions based upon Aristotle's enthymeme topics were adapted from his Rhetoric, specifically Book II, Chapter 23: 1397a17-1400b35. Remembering that when Aristotle writes about invention he is most concerned with enabling one to discover the most suitable argument for persuading an audience, one realizes most of his explanations are really examples of how a select topic may be applied in a certain situation. Here is the description of the topics students saw (if they wished) when they ran the topoi software:

> I'm glad you asked. . . . Briefly, the twenty-eight enthymeme topics help a writer (or a speaker) discover specific arguments about subjects.
>
> In his Rhetoric, Aristotle tells us that the aim or goal of rhetoric is to persuade an audience. Remember that term--persuade.
>
> Aristotle believed that if his students in the Academy knew and practiced using the topics, they would become effective "persuaders."
>
> You'll recognize among the topics:
> 1. questions of definition;
> 2. questions about causes and effects;
> 3. questions regarding opposites and associations;
> 4. questions about consequences;
> 5. and questions about matters of fact and opinion.

The questions based upon Kenneth Burke's dramatistic pentad were derived from A Grammar of Motives (1969). The five key terms of dramatism--Act, Scene, Agent, Agency, and Purpose--represent the specific perspectives all men share in the "attributing of motives" (p. xv). Specifically, Burke contends that "any complete statement about motives will offer some kind of answers to these five questions: What was done (act), when or where it was done (scene), who did it (agent), how he did it, (agency), and why (purpose)" (p. xv). Burke's rhetoric differs from classical rhetoric in that his major concern is not persuasion but "identification" (Burke, 1951; Corbett, 1971; Kinneavy, 1971; Young, 1976). In the actual CAI module, the pentad heuristic was described this way:

Briefly, Kenneth Burke's dramatistic pentad encourages a writer to think about a subject from five perspectives.

1. Scene — Where and when something happens.
2. Act — What happens
3. Agent — Who causes what happens to happen.
4. Agency — By what means does something happen.
5. Purpose — Why something happens.

Burke also encourages writers to see the relationships among these perspectives. He calls these relationships the ratios.

The science of human behavior and, specifically, the science of verbal behavior form the context for tagmemic invention. Richard Young, Alton Becker, and Kenneth Pike explain the tagmemic matrix as a rhetorical heuristic in their text Rhetoric: Discovery and Change (1970). The heuristic procedure itself combines four maxims for understanding a writer's position in relationship to the world, an audience, and a language system. The fourth maxim was the most important in terms of this research: "A unit of experience can be viewed as a particle, or as a wave, or as a field. That is, the writer can choose to view any element of his experience as if it were static, or as if it were dynamic, or as if it were a network of relationships or part of a larger network" (p. 122). Essentially, tagmemic invention emphasizes "psychological changes in the writer" and focuses on the "retrieval of relevant information already known, analysis of problematic data, and discovery of ordering principles" (Young, 1976, p. 23). Consequently, the students had the opportunity to see this description of the tagmemic system when they ran that particular program:

Briefly, the tagmemic matrix encourages a writer to think about a topic from nine perspectives. For this program, however, I have simplified this a bit. This program will ask you questions from only three perspectives, which you will recall from our class discussion.

1. Particle — Viewing a subject in itself (static);
2. Wave — Viewing a subject as it changes (dynamic); and
3. Field — Viewing a subject's relationship to other subjects (in a system).

Research Hypotheses

On the basis of such pedagogical and heuristic considerations, a four-group, pretest-posttest research design attempted to test the following ten hypotheses:

1. As described by an anonymous Likert questionnaire, the experimental subjects will share an overall positive attitude toward the CAI units. This descriptive hypothesis will be supported if the overall item score's mean exceeds 3.5 on the five-point Likert scale.

2. Over ninety-five percent of the experimental subjects will sustain an invention dialogue for the full duration of the thirty-minute posttest, and there will be no difference among the three groups.

3. Subjects will answer seventy-five percent of the non-data conditioned questions presented in the thirty-minute posttest and extend the inquiry (i.e., answer the question and elaborate on their response at least once) sixty percent of the time. Additionally, there will be no difference in the rates among the experimental and control groups.

4. There is no difference in an individual's quantitative performance on a pretest and a posttest as measured by a surface-cued, proposition analysis. This hypothesis is to be tested at the .05 level of significance.

5. There is no difference in an individual's qualitative performance on a pretest and a posttest as measured by a panel of composition teachers using a scale emphasizing evidence of insightfulness, comprehensiveness, and linguistic cues of intellectual processing. A t-test for correlated samples will be used to test this hypothesis at the .05 level of significance.

6. Three weeks after the lectures and the on-line treatment, the experimental subjects will be able to generate ten questions about a selected subject from their respective heuristic strategies. Moreover, there will be no difference in the internalization performances among the three experimental treatment groups as evaluated by a panel of experienced composition teachers.

7. There is no difference in the quantitative performance on a pretest and a posttest among the four groups. Additionally, there is no difference in the quantitative performances among the three experimental treatment groups. The level of significance will be .05.

8. There is no difference in the qualitative performance on a pretest and a posttest among the four groups. Furthermore, there is no difference in the qualitative performances among the three CAI-prompted groups. Again, the significance level will be .05.

9. There is no difference in the qualitative performance (criteria being insightfulness, comprehensiveness, maturity, suitability of arrangement, helpfulness, and holistic impression) among the composition plans of the four groups as evaluated by experienced composition instructors. Using analysis of covariance, this hypothesis will also be tested at the .05 significance level.

10. There is no correlation between quantitative and qualitative performances and SAT verbal score, ECT placement score, and the previous semester's grade in composition. A Pearson correlation coefficient will describe the strength of the various relationships.

The Tasks

The first developmental task was to design a sequence of instructional prewriting questions which would enable a machine to simulate three particular, non-data conditioned perspectives for investigating a subject. These questions, however, had to be (at worst) answerable and (at best) interesting, appropriate, and fruitful. After a pilot study validated the heuristic question pools, the next phase was to program these modules for the on-line experiment.

Unlike traditional programmed instruction and computer-assisted instruction of the drill and practice variety in which the answers are "known" (i.e. stored in the program's memory), these programs were designed to give one appropriate, though non-data conditioned, response. The programs could not verify a "right" response nor challenge a "wrong" response. Moreover, unlike laboratory instruction and computer simulation instruction in which the students' responses necessarily

determine the next step, these invention modules generally relied more on counting the number of responses and the availability of other heuristic questions than on specific, declarative responses. Questions and certain commands helped the student control the direction of the inquiry, but exclusive control generally was not exercised by students. In the pentad and tagmemic programs, however, students had a little more flexibility in that they could command the system to ask questions from a specific perspective of the heuristic, i.e. "act!" or "scene!"/"wave!" or "field!". Overall, therefore, the interaction was designed to allow for active student involvement, machine heuristic manipulation, and cathode ray tube (CRT) compatibility.

The most challenging part of the programming was anticipating the ways in which the writers would indirectly ask for clarification. A keyword subroutine anticipated up to twenty-seven strings. These strings, combined with the randomness of the question selection and the pools of individualized responses, gave the programs a richness which exceeded the expectations of the prototype. The Aristotle program allowed 3,216,320 branching possibilities from the welcoming sequence through the full exploration of the first question. The Burke and the tagmemic modules allowed more possibilities since a writer could select specific heuristic perspectives--6,272,000 and 5,408,000 respectively.

The Experimental Procedures

Subjects. Students in four second-semester English composition classes at the University [redacted] volunteered to participate. The specific course, English 308, emphasized "reading persuasive and argumentative essays, and writing

with the use of the aims and modes of discourse." No literature was taught; rhetorical principles were stressed. Seventy-two subjects volunteered to participate and took the pretest, and sixty-nine subjects completed the treatment and the posttest. The mean SAT verbal score for these sixty-nine students was 443.48. Their ECT mean score was 393.91. Their mean first-semester English G.P.A. was 2.46 on a four-point scale, and their mean high school (10-12) performance was 72.23. Sixty-seven subjects completed the follow-up composition plan within the required time limit. Only the experimental groups wrote the internalization exercise and completed the attitude questionnaire; forty-eight subjects completed these instruments, five subjects being absent.

Treatment. While the seventy-two subjects were assigned to four distinct English 308 sections, the treatments were randomly assigned to the classes. The slightly unequal number among the treatments resulted from the differences in class size as well as the number of subjects who voluntarily gave their consent. All subjects, including those in the control group, were aware that they were involved in an experiment involving computer-assisted instruction in invention. Those members in the control group were given the opportunity to use the computer programs after the pretest, the posttest, and the composition plan had been completed; three actually did so. To control for teacher variability, I presented to each of the four groups two one-hour lectures about their heuristic strategy. The control group's lectures concerned the problem-solving or creative process, i.e., "preparation, incubation, illumination, and verification."

During the week of the lectures, the experimental subjects were scheduled for an on-line practice session. These thirty-minute practice sessions were conducted in

order to familiarize the subjects with the operation of the Lear Siegler ADM-3A interactive display terminal, a CRT. Specifically, the subjects were taught the keyboard characteristics including its cursor control keys and special keys for system control (e.g., RETURN, SHIFT, RUBOUT, CONTROL, etc.) The practice sessions also allowed the subjects to review the invention program's directions including the direct commands and the question-asking features. At the conclusion of the practice session, each subject was given an informal mastery test on the system and the program controls.

The posttest administration began the following week. The motto for the posttest was "If you think it, type it!" The control group was told "If you think it, write it down." All the subjects in the experimental sections were logged on to the system by a member of the research team. After the first question appeared, they were timed for thirty minutes. The only encouragement came from the program itself. Two subjects had to be rescheduled for the posttest because the computer "crashed" after they had been logged in. The posttest for the control group was administered in class. Their instructions were to list any and all ideas they had about the topic of their research paper. They also had thirty minutes, and again there was no additional encouragement if they stopped writing before the thirty minute time limit expired.

Measures

Validating the measures of quantitative and qualitative growth of ideas eventually became a crucial, nearly primary, focus of this research. The quantitative measure was derived from Walter Kintsch's research with propo-

sitional representations (1974). The qualitative measures synthesized features which Kinneavy (1971) and Odell (1977) emphasized in their descriptions of invention.

First, a reliable measure was needed to count the ideas; Kintsch's propositional system became the starting point, for he correlates surface representations with propositional analyses. Although he does not assign specific numeric values to the propositional analysis, the propositional elements are arranged in such a way that they could be summed and reported as a specific number of ideas. From this point, a systems approach to counting propositions and ideas was developed (Figure 1). The aim of this system flowchart essentially was to nudge the intuition toward consistency. Indeed, Kintsch's work ultimately explores the deep, elemental representations of semantic density. However, developing a reliable and practical instrument for measuring the accumulation of semantic information should, I felt, dwell close, quite close, to the explicit surface representations. The three evaluators who measured the quantity of ideas on the 138 tests in the final experiment obtained a interrater reliability of .98355 (see Table 1).

Second, as these invention modules were intended to stimulate a growth in the sophistication of the insights, to encourage a visible change in the comprehensiveness or range of ideas, to prompt an observable, linguistically-cued interaction between a heuristic and a subject, and to increase the overall "quality" of a list of ideas about an individual topic, qualitative measures were formulated. Evaluation using these measures would attempt to estimate on a five-point continuum the

subjects' performances in terms of their insightfulness, their comprehensiveness, their intellectual processing, and their overall sophistication. Later, for the composition plan's qualitative evaluation, arrangement as "structuring principle" was partialed out of the comprehensiveness category; also, intellectual processing was dropped and two categories--maturity and helpfulness--considered in its place. Since the composition plan was a single-test, dependent variable, a four-point continuum prevented the evaluators from collapsing scores toward the middle.

Therefore, for the first two qualitative guidelines, the three evaluators made their judgments based on these definitions:

> "Evidence of Factuality, Surprise Value, Interest, Inventiveness, Insightfulness"--Evaluate the writer's discoveries. Does the writer discover new, specific information? Does the writer demonstrate interest by using a particular slant, a point of view? Has the writer attempted some "lateral thinking," some creative responses? Is there any evidence of an "epiphany" or an "ah ha!"
>
> "Evidence of Scope, Comprehensiveness, Relative Completeness"--Evaluate the writer's perception of the total topic. Has the writer decided on the range of the topic? Is this range of ideas or scope appropriate for a research paper? Does the writer seem to use some structuring principle (i.e. alphabetical, numerical = low value systems; chronogical, spatial = mid-value systems; classificatory, evaluative, deductive systems = high value systems).

The guideline for evaluating the quality of the subjects' intellectual processing sought for the evaluator to attend to surface features which cued intellectual interaction. For this third qualitative guideline, the three evaluators determined a score based on the following definition:

"Evidence of Intellectual Processes (focus, contrast, classification, change, sequence)"--Evaluate the writer's apparent mental agility by attending to linguistic cues. Focus = useful subject selections? Contrast = extensions to ideas by connectors, comparative/superlative forms, negatives, negative affixes, lexicon (i.e. difference, paradox, etc.)? Classification = syntax (NPs suggesting class), for example, for example; lexicon (i.e. similar, resemble, class, category, parts)? Change = VPs with change or synonym (realize, become aware, stopped thinking about, began noticing, etc.)? Sequence = time (i.e. when, subsequently, earlier etc.), cause-effect (because, since).

Finally, the evaluators were also asked to report their overall impression based upon the following definition:

"Overall Impression"--Probably an average of the above three categories, but you may also consider the writer's effort, the complexity of the topic, the timed nature of the assignment, or whatever you wish. Call it "holistic" latitude of wise, intelligent, professional evaluators.

The evaluation of the composition plans' quality added these three definitions:

"Maturity"--Evaluate the complexity of the topic and the writer's attitude toward the topic. Objectiveness and overall tone may be useful guidelines. How thorough is the analysis?

"Arrangement"--Evaluate whether or not the writer has selected an appropriate arrangement for the research paper. How true will the writer be to the overall structural principle in the plan? Or do you suspect there will have to be major changes?

"Helpfulness"--Evaluate whether or not the writer will actually use this plan as a "springboard" for the research phase. Does the plan help the student understand what he or she must now find out?

During a two-hour training session, the three quality evaluators discussed each category, clarified some of the toughest distinctions (e.g., valued "structuring principles"), and practiced evaluating samples drawn from the earlier pilot study.

The realiability scores for the pretest-posttest evaluation are presented in Table 2. The greatest agreement was found in their judgments about evidence of factuality, surprise value, insightfulness (Alpha=.83072) and their overall impression (Alpha=.81481). The reliability scales for the composition plan evaluation are reported in Table 3. The strongest reliability score here was in the "comprehensiveness" category (Alpha=.80305); the second strongest agreement was in "arrangement" (Alpha=.79076). The least agreed upon category was "maturity" (Alpha=.68106).

The same evaluators who measured the quality of the invention sequences also evaluated heuristic internalization. They were asked to read the questions and report what heuristic method they believed the student used to write these questions. In Table 4, the two reliability scales illustrate (1) overall agreement with the intended heuristic method, and (2) the reliability among the evaluators themselves.

Findings

Empirical results about invention and cognitive strategies are bound to be perplexing since they must measure what our intuitions tell us is unmeasurable. Evaluating ideas, after all, is much different than counting a horse's teeth. What this inductive paradox may testify to, I hope, is that important questions are being asked.

Results for Hypothesis One--Attitude. Since the attitude results are not analyzed separately for the three heuristic treatments, the major question actually being asked is: "How did freshman composition students like computer-assisted invention?" Overall, the findings were positive. Generalizing over all of the subjects, the strongest agreement was with statements one ("I think freshman college students generally need help with prewriting"), nine ("The computer program made me think"), and twenty-four ("From experiencing this instruction, I understand how heuristic questions could be applied to lots of topics"). The grand mean for all twenty-five items was 3.6404, slightly above the hypothesized 3.5 criterion.

Results of Hypothesis Two--Rates of Completing Treatment. Hypothesis two--that over ninety-five percent of the experimental subjects would sustain the invention dialogue under the imposed experimental conditions for thirty minutes--was supported. Fifty-two of the fifty-three subjects (98.1%) worked until the research assistant had them command the program to "stop!" In terms of the percentage of interaction treatment minutes, the students worked for 1580 out of a possible 1590 treatment minutes, or 99.4% of the alloted time. An encouraging descriptive finding was that several students objected to ending their sessions; they wished to continue the inquiry and reported that thirty minutes was too short a time to think about their topic.

Results of Hypothesis Three--Construct Validity. For the three experimental groups, the number of times they answered a question once and the number of times they extended their answers were counted. All of the groups exceeded the hypothesized criteria for answering and elaborating their answers. The specific hypothesis was that experimental subjects would answer seventy-five percent of the

non-data conditioned questions presented in the thirty minute posttest and extend their inquiry at least sixty percent of the time. The Aristotle group answered their questions 97.25% of the time and extended their inquiry 90.02% of the time. The subjects undergoing the Burke treatment answered their first question 91.24% of the time and elaborated their answers 69.25% of the time. The tagmemic subjects answered their first questions 92.28% of the time and gave additional information 77.73% of the time.

Results of the analysis of variance on these data indicated no significant difference among the groups regarding their ability to answer the heuristic question the first time ($F=1.072$, $p=.350$; see Table 5); however, a statistically significant difference among the groups on their elaboration performance was discovered ($F=3.927$, $p=.026$; see Table 6). Additionally, an analysis of covariance by group with the SAT verbal score (two missing cases) as the covariate verified the above significant finding ($F=3.535$, $p=.037$; see Table 7). A multiple classification analysis of the analysis of covariance (Table 8) was performed to confirm the observed trends seen in the raw percentage performances; i.e., the topoi group most easily extended their answers and the pentad group did not greatly elaborate their initial remarks.

Results for Hypothesis Four--Individual Quantitative Gains. After the total proposition count had been completed, the fifteen-minute pretest score was doubled so that it could be more appropriately compared to the individual's thirty-minute posttest score. Tables 9 to 12 present these results in the four groups. Briefly, though, all three experimental groups showed statistically significant gains, while the control group suffered a statistically significant decrease in the quantity of

ideas. In the pretest, the nineteen members of the topic group listed an average of 35.5789 ideas; the seventeen members of the Burke group listed 30.7647 ideas; the seventeen students in the tagmemic class listed an average of 27.2353 ideas; and the sixteen students in the control class wrote an average of 29.4375 ideas in the allotted fifteen minutes. In the posttest, the members of the Burke class wrote an average of 133.1765 ideas per student; those students in the Aristotle class wrote an average of 125.9474 ideas; the individuals in the tagmemic group wrote 107.6471 ideas per student. The control group, interestingly, wrote an average of 45 ideas per student in the thirty minutes, not even double the ideas they were able to write in the fifteen-minute exercise.

Results of Hypothesis Five--Individual Qualitative Gains. A t-test for correlated samples found that all individuals including those in the control group made qualitative gains, though the gains in the control group lagged behind the individual gains experienced by those in the experimental groups. No adjustments were made for the time differences. As Table 13 illustrates, the "factuality, surprise value, insightfulness" category saw all individuals make a statistically significant increase (p=.000* for the experimental groups; p=.011 for the control group). The comprehensiveness category, reported on Table 14, saw a statistically significant gain among the members of the three experimental groups (p=.000 for the Aristotle and tagmemic treatment; p=.001 for the Burke treatment). In this category, however, the control group's individual gains failed to reach significance (p=.177).

* The SPSS-10 program calculates significance only to three decimal places.

The category regarding the evidence of the intellectual processing (see Table 15) again saw significant individual gains (p=.000) in all experimental groups. However, the control group's individual performances approached but did not reach a statistically significant figure (p=.052). Table 16 reports the results of the overall quality of these pre-post lists of ideas. Again, all of the experimental treatments yielded a p=.000 significant level while the control group's individual performances did not quite yield a significant number (p=.051).

Perhaps, it is not surprising that an increase in the treatment time "ought" to mean an increase in the quality of what is written. These results indicate, in a strict inferential model at least, that facts and insights increase for individuals, but that the comprehensiveness of their inquiry, the flexibility of their intellectual repertoire, and the net qualitative effect could have as easily occurred by chance. What this finding may suggest is that the time spent stimulating invention perhaps should be devoted to comprehensive systems and heuristics which immediately encourage interaction. Let it suffice to say that since gains occurred in all groups, the more discriminating qualitative hypothesis is hypothesis eight, since it attempts to show the extent of the differences among the groups.

Results of Hypothesis Six--Heuristic Internalization. The results of the internalization hypothesis showed that members of each experimental group did indeed remember and could generate some recognizable heuristic questions. The mean performances on a four-point scale were 3.7 for the Aristotle treatment, 3.41 for the Burke treatment, and 3.14 for the tagmemic treatment. An analysis of the covariance with the SAT verbal score and the ECT score as the covariables (see

Table 17), however, showed no significant difference among the groups (F=1.783, p=.182). A multiple classification analysis (see Table 18) indicated a slight trend favoring the internalization or the "clear-cut" recognizability of Aristotelian topoi. The trend also showed that either the tagmemic method was the most difficult heuristic for generating "recognizable" questions or that the evaluators had the most difficulty recognizing students' "tagmemic" renditions. Finally, the Burke heuristic approach remained in the middle--surprisingly, since the who, what, where, when, and why strategy was assumed to be the most familiar.

Results of Hypothesis Seven--Quantity Among Groups. Hypothesis seven--that there is no difference in the quantitative performance on a pretest and a posttest among the four groups--was rejected, for statistically significant differences were discovered among the four groups. First of all, though, an analysis of covariance on the pretest performance, with the SAT verbal and the ECT scores as covariables, showed no statistically significant difference among the four groups (F=1.050, p=.378; see Table 19). Moreover, a multiple classification analysis (Table 20) ranked the quantitative pretest performances as follows: (1) Aristotle, (2) control, (3) Burke, and (4) tagmemic.

As Table 21 illustrates, the results of an analysis of covariance, with the SAT verbal and the ECT scores as covariables, on the posttest was statistically significant (F=12.334, p=.000). The multiple classification analysis in Table 22 shows that the performance ranks switched from the pretest: now (1) Burke, (2) Aristotle, (3) tagmemic, and (4) control. Even more important, this significance level is gained because the control group bears the entire burden of both the unadjusted deviation

and the adjusted deviation. Consequently, as the Beta illustrates, the groups are more unlike each other after the covariate adjustments. This finding may be the one finding in which we may have the "greatest confidence." The CAI-units stimulated lots of ideas, many more than students without this treatment were able to generate.

Among the three experimental groups, an analysis of covariance found the pretest quantity main effects not statistically significant (F=1.006; p=.373; see Table 23); the multiple classification analysis here (Table 24) ranked the pretest performances: (1) Aristotle, (2) Burke, and (3) tagmemics. The analysis of covariance found the posttest difference for main effects even less significant (F=.805; p=.453; see Table 25); the multiple classification analysis in Table 26 revealing these changed rankings: (1) Burke, (2) Aristotle, and (3) tagmemics. The identical Beta shows that these three groups have virtually remained unchanged after the covariate adjustment.

Results of Hypothesis Eight--Qualitative Group Performances. In general, the results of the four qualitative distinctions found significant differences in favor of the three heuristic treatments. In every category, after the deviation on the posttests had been adjusted for the covariables--SAT verbal and ECT scores--the control group was entirely responsible for the negative values. Furthermore, the additional analyses of covariance--with the SAT verbal score as the single covariable--run on the three heuristic treatments themselves found more significant differences on the pretest than on the posttest. In other words, the

treatments were making the three experimental groups more alike with respect to their collective insightfulness, comprehensiveness, intellectual ability, and overall qualitative performance. These particular findings are explained below in more detail.

An analysis of covariance found no significant difference on the pretest for factuality, surprise value, and insightfulness ($F=1.516$, $p=.220$; see Table 27). The multiple classification analysis (Table 28) showed the Aristotle group ranked first; control, second; Burke, third; and the tagmemic group, fourth. The posttest's analysis of covariance reported a significant difference among the groups ($F=13.148$, $p=.000$; see Table 29) with the control group bearing the full weight of the negative deviation (see Table 30). The ranks of the groups became (1) Aristotle, (2) tagmemics, (3) Burke, and (4) control.

Among the three heuristic groups, an analysis of covariance on the pretest scores found no significant difference ($F=1.707$; $p=.192$; see Table 31). The multiple classification analysis (Table 32) shows that the groups became more alike after the adjusted deviation calculations. As was the case for the quantitative evaluation, an analysis of covariance found that the heuristic treatments made the groups' differences even less significant ($F=.993$, $p=.378$; see Table 33). The multiple classification analysis (Table 34) indicated that the Burke treatment tended to decrease slightly while the tagmemic treatment increased that group's insightfulness; the Aristotle treatment comparatively remained more "insightful." Still, what must be emphasized is that the CAI-invention treatments made these three groups more alike.

The analysis of covariance on the pretest evaluation for "comprehensiveness" found no statistically significant difference among the four groups ($F=1.681$, $p=.182$; see Table 35). The relative "comprehensive" performances (Table 36) found the groups ranked (1) Aristotle, (2) control, (3) Burke, and (4) tagmemics. The results of the posttest found a significant difference among the four groups ($F=7.563$, $p=.000$; see Table 37). The most comprehensive group was the Aristotle group; also, the control group, after the adjusted deviation, bore the entire negative deviation (see Table 38).

One of the most interesting results in this study was discovered when an analysis of covariance found a significant difference on the pretest "comprehensiveness" among the three experimental groups ($F=3.613$, $p=.035$; see Table 39). The multiple classification analysis (Table 40) illustrated that the tagmemic pretest's adjusted deviation (-1.04) was the major reason for this significant difference. The posttest analysis of covariance found no statistically significant difference among the groups ($F=1.334$, $p=.273$; see Table 41). Again, the multiple classification analysis in Table 42 confirmed that the experimental differences were decreasing.

Regarding the evidence of intellectual processing in the pretest performances among the four groups, an analysis of covariance found no significant difference ($F=1.663$, $p=.186$; see Table 43). The multiple classification analysis (Table 44) illustrated the respective rankings: (1) Aristotle, (2) control, (3) Burke, and (4) tagmemics. The posttest results showed a significant difference among the four groups ($F=13.332$, $p=.000$; see Table 45). Interestingly, the multiple classification analysis showed a distinct improvement in the tagmemic treatment and, again,

another adjusted deviation which favored all of the experimental groups over the control group (see Table 46).

The results of an analysis of covariance among the three experimental groups pretest performance were statistically significant ($F=3.411$, $p=.041$; see Table 47); the multiple classification analysis (Table 48) illustrated the tagmemic group fared poorly in comparison to the scores of the other two groups. In the posttest, however, an analysis of covariance could find no statistically significant difference among the groups ($F=.941$, $p=.397$; see Table 49). The Burke group declined though and the tagmemic group improved, so much so that their respective pretest positions were reversed (see Table 50).

The general patterns already established were verified in the statistical analyses for "overall quality" of these lists of ideas: a significant posttest difference among the four groups and a gravitational tendency among the three experimental groups to reconcile statistical differences on the dependent posttest variable.

Specifically, an analysis of covariance showed no difference among the four groups on the overall quality of their pretest ($F=1.241$, $p=.304$; see Table 51). The multiple classification analysis (Table 52) revealed no surprises: the rankings being (1) Aristotle, (2) control, (3) Burke, and (4) tagmemics. The results of the posttest showed a significant difference among the four groups ($F=10.658$, $p=.000$; see Table 53). Like the other qualitative multiple classification analyses, this multiple classification analysis (Table 54) saw the total burden of the adjusted negative deviation fall into the control group's domain.

Among the three experimental groups, the analysis of covariance on the pretest measure for overall quality reported no significant difference ($F=2.110$, $p=.133$; see Table 55), and the multiple classification analysis (Table 56) echoed the previous pretest rankings: (1) Aristotle, (2) Burke, and (3) tagmemics. The analysis of covariance on the posttest revealed even less significant differences among the three groups ($F=1.426$, $p=.251$; see Table 57). Also, the multiple classification analysis (Table 58) again revealed the tendency for the Burke group to decline and the tagmemic group to improve while the Aristotle group remained steadily at the top.

Results of Hypothesis Nine--Composition Plan Quality. None of the statistical tests comparing the quality of the composition plans among the four groups was statistically significant. The general pattern revealed that the Aristotle group ranked first, the control group ranked second, the tagmemic group ranked third, and the Burke group ranked fourth, though some interesting rank switching occasionally occurred. Consequently, the gains experienced by the three heuristic groups in quantity and quality of "raw material" did not significantly carry over to the "arrangement" phase of the prewriting process.

Results of Hypothesis Ten--Significant Correlations. The Pearson product-moment correlation coefficient test was run to determine whether there were significant relationships between dependent measures. For the most part, positive correlations were found crossing the SAT verbal score, the previous semester's English grade, and the student's high school rank with the quantitative results, the insightfulness

findings, and the overall quality results. These positive correlations were not statistically significant; Table 59 presents this data.

Implications

The major rhetorical dilemma in future invention research is this one: how does a researcher empirically compare heuristic strategies when those strategies inherently tend to make all groups more alike? Only once in this reseach was there a significant difference among the three experimental groups--that difference concerning the elaboration rates or ease with which the members of the group continued answering a question. Here, the topoi method was the most likely to sustain an inquiry and the Burke method was the least likely to sustain the inquiry. What confounds this finding, however, is that the Burke pentad stimulated more "propositions" on an average.

The point, though, is this: as any heuristically-guided inquiry proceeds from its original premises, the inquiry expands to comprehend more and more reality, more and more perspectives. This heuristic expansion resembles the proverbial pebble-in-the-pond. For example, in terms of the three heuristic methods in this research, a Burke "act" quickly overlaps the dynamic, wave point of view, which in turn overlaps considerations of time--the fifth enthymeme topic. If a creative, comprehensive inquiry happens, then heuristic-combining naturally occurs.

What must be grappled with pedagogically is (1) whether or not these CAI modules stimulate invention as well as (or better than) current instruction in invention, or (2) whether they effectively supplement current invention instruction.

This study contributes some evidence that three heuristic strategies via CAI are better than what little individualized invention actually occurs in the composition classroom, at least as far as quantity, comprehensiveness, intellectual processing, and overall quality of ideas are concerned. Stimulating invention in English composition through computer-assisted instruction is (1) possible, (2) quantitatively effective, (3) qualitatively effective, and (4) individualized. Stimulating ideas via CAI is not (1) madness, (2) terribly costly, (3) boring, or (4) a passing fad. Classroom lectures and general heuristic discussions alone, this research indicates, do not reach the heart of the matter--the systematic use of a particular inquiry tool on students' individual topics. However, the study is inconclusive about whether or not such instruction actually helps writers write. The data collection stops short of a complete evaluation of the final research papers. Still, one pedagogical matter may be discussed.

One of the dangers of stimulating invention is overstimulation. Although the ultimate finding was not significant, the performance on the composition plan under the category of "suitable arrangement" favored the control group. The phenomenon of "rhetorical overload" is often blamed for students' inability to write; they so worry about the ideas, the arrangement, and the style of the finished product all through the composing process that they burn themselves out. What prevents the memory from overloading during the invention stage? A sense of arrangement?

Aim? Number of pages? Specificity of the subject? Student's motivation? All of these responses seem probable. Others quickly come to mind, but suffice it to say that, rhetorically, writers must account for the reality, the audience, the message, and their own perceptions. That first rhetorical task confronts them during the invention stage; it may be overwhelming for the inexperienced writer who has not yet discriminated the parts from the whole.

Conclusion

This research combined the renewed interest in teaching the first rhetorical art, inventio--the systematic process of exploring a subject in order to discover new insights and persuasive arguments, or recover ideas, facts, and opinions from memory--with the developing technology of instructional computing.

The primary developmental findings were: (1) CAI could be programmed which encouraged both growth in the number and the sophistication of ideas; (2) questioning dialogues could help students articulate, refine, and preserve their ideas; (3) such questioning dialogues could ignore content in favor of perspective and still help students begin writing; and (4) theories of creativity based on intersecting content and perspective were programmable today and were certain to be even more programmable in the future.

Although these invention programs incorporated a limited semantic understanding, they followed a current developmental trend for programs to emulate the

verbal behavior of intelligent, personal, inquisitive human tutors. The success and perhaps innovation of these programs is that they represent the first attempt to have an "open" instructional system--i.e., a computer-based package which does not have an associated body of content from which to draw appropriate answers.

The first of two important research findings was that such a systematic inquiry using either Aristotle's twenty-eight enthymeme topoi, Kenneth Burke's dramatistic pentad, or the tagmemic matrix of Richard Young, Alton Becker, and Kenneth Pike made three experimental groups more alike with respect to the quantity and quality of their ideas. Additionally, these three experimental groups differed significantly from a control group with respect to the number of ideas generated, the insightfulness and factuality of the ideas, the comprehensiveness of those ideas, the surface-cued intellectual processing evident in the sample writings, as well as the overall quality of the inquiry.

The second important finding was that computer-administered, posttest methodology represented a more stringent way for controlling and perhaps later replicating quasi-experimental research in rhetoric. The most beneficial consequence of this study may be the introduction of the computer as a way to increase the reliability and the validity of what researchers in the humanities and researchers in humanities education actually research. Admittedly, the fear and trembling which Ellen Nold reported in 1975 still exists, but, if empirical research in rhetoric and English education is to gain any credibility, then the profession must have confidence in the researcher's methodology.

Yes, a rhetorical renaissance has recently emerged within the teaching of English composition, but so has an electronic revolution. What this research illustrates above all else is that rhetorical invention and computer technology are indeed compatible; combining heuristic "modes" and computer "media" can well serve and gladly teach the inquisitive writer. Briefly, the CAI modules significantly stimulated both quantity and quality of ideas over a control treatment. The experimental groups, however, became more alike after the computer-administered treatment; consequently, further comparative studies of the Aristotelian topoi, the dramatistic pentad, and the tagmemic matrix may have difficulty achieving statistically significant differences among the groups. Nevertheless, while there were no significant differences among the three experimental groups, some heuristic "trends" may be worth further study. The pentad seemed the most fluent; the tagmemic, the most intellectually interactive; and the Aristotle, the most insightful and the most comprehensive. Stimulating invention in English composition through computer-assisted instruction is an effective way to begin teaching the art of systematic inquiry and a most appropriate introduction to the richness of heuristic strategies in general. While less desirable than the philosophers' stone, computer-assisted invention can be provided.

Sources

Aristotle. The rhetoric and the poetics of Aristotle. (W. R. Roberts, I. Bywater, trans.). New York: Modern Library, 1954.

Burke, K. A grammar of motives. Berkeley: University of California Press, 1969.

Burke, K. Rhetoric--old and new. Journal of General Education, 1951, 5, 202-209.

Corbett, E. P. J. Classical rhetoric for the modern student (2nd ed.). New York: Oxford University Press, 1971.

Kinneavy, J. L. A theory of discourse: The aims of discourse. Englewood Cliffs, N. J.: Prentice-Hall, 1971.

Kintsch, W. The representation of meaning in memory. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers, 1974.

Lauer, J. M. Invention in contemporary rhetoric: Heuristic procedures (Doctoral dissertation, The University of Michigan, 1967). Dissertation Abstracts International, 1967, 28, 5060-A.

Nold, E. Fear and trembling: The humanist approaches the computer. College Composition and Communication, 1975, 26, 269-273.

Odell, L. Measuring changes in intellectual processes as one dimension of growth in writing. In C. R. Cooper and L. Odell (Eds.), Evaluating Writing: Describing, Measuring, Judging. Urbana, Ill.: National Council of Teachers of English, 1977.

Young, R. E., Becker, A. L., & Pike, K. L. Rhetoric: Discovery and change. New York: Harcourt, Brace and World, 1970.

Young, R. Invention: A topographical survey. In G. Tate (Ed.), Teaching Composition: Ten bibliographical essays. Fort Worth: Texas Christian University Press, 1976.

TABLES

FIGURE 1

A SYSTEMS APPROACH FOR COUNTING PROPOSITIONS/IDEAS

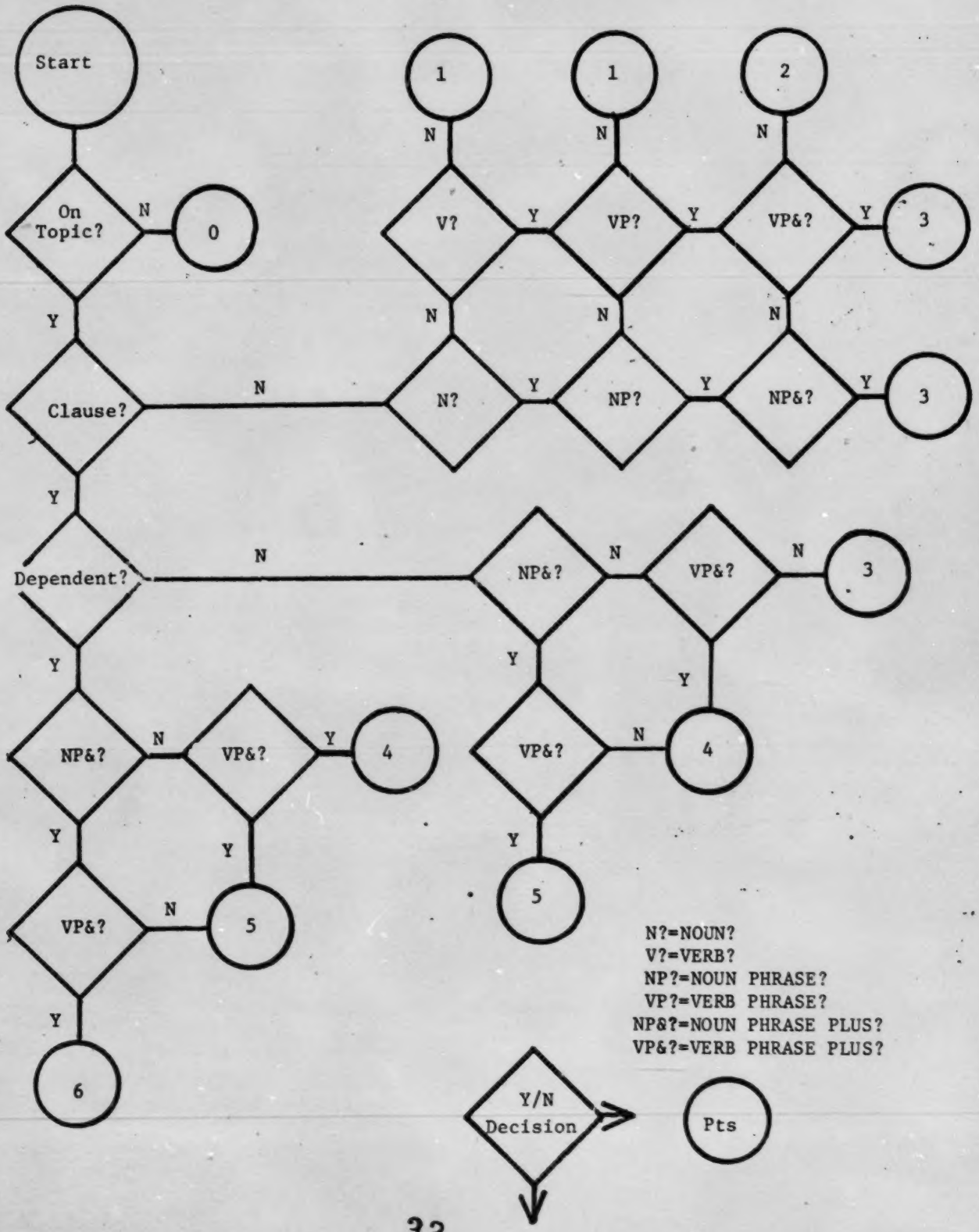

Table 1

MEANS, STANDARD DEVIATIONS, CORRELATIONS, AND ALPHA RELIABILITY FOR QUANTITATIVE EVALUATION

	Means	Std. Dev.
I	77.42754	66.17097
II	58.36957	45.90105
III	67.24638	55.82700

Correlation Matrix

	I	II	III
I	1.00000		
II	0.98171	1.00000	
III	0.98393	0.98610	1.00000

RELIABILITY Coefficients 3 Items

Alpha = 0.98355 Standardized Item Alpha = 0.99458

# of cases = 138.0

Table 2

ALPHA RELIABILITIES FOR PRETEST/POSTTEST
QUALITATIVE EVALUATION

	RELIABILITY Coefficients	3 Items
"Factuality, Surprise Value, Insightfulness"	Alpha = 0.83072	Standardized Item Alpha = 0.84099
"Comprehensiveness"	Alpha = 0.75616	Standardized Item Alpha = 0.76489
"Intellectual Processing"	Alpha = 0.79591	Standardized Item Alpha = 0.80076
"Overall Impression"	Alpha = 0.81481	Standardized Item Alpha = 0.82558

# of cases = 138.0

Table 3

ALPHA RELIABILITIES FOR COMPOSITION PLAN
QUALITATIVE EVALUATION

	RELIABILITY Coefficients	3 Items
"Insightfulness"	Alpha = 0.76117	Standardized Item Alpha = 0.76238
"Comprehensiveness"	Alpha = 0.80305	Standardized Item Alpha = 0.80434
"Maturity"	Alpha = 0.68106	Standardized Item Alpha = 0.68175
"Arrangement"	Alpha = 0.79076	Standardized Item Alpha = 0.79067
"Helpfulness"	Alpha = 0.71547	Standardized Item Alpha = 0.73240
"Overall Impression"	Alpha = 0.74093	Standardized Item Alpha = 0.74936

# of cases = 69.0

Table 4

CORRELATION MATRIX AND ALPHA RELIABILITIES
FOR THE EVALUATION OF HEURISTIC
INTERNALIZATION

Correlation Matrix

	Heuristic	I	II	III
Heuristic	1.00000			
I	0.67727	1.00000		
II	0.95266	0.70360	1.00000	
III	0.62213	0.51172	0.62335	1.00000

RELIABILITY Coefficients

4 Items

Alpha = 0.89733 Standardized Item Alpha = 0.89551

3 Items

Alpha = 0.82691 Standardized Item Alpha = 0.82608

# of cases = 45.0

Table 5

ANALYSIS OF VARIANCE FOR HEURISTIC ANSWERING RATE
AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Main effects	375.186	2	187.593	1.072	0.350
Group	375.186	2	187.593	1.072	0.350
Explained	375.186	2	187.593	1.072	0.350
Residual	8750.625	50	175.013		
Total	9125.811	52	175.496		

53 cases were processed.

Table 6

ANALYSIS OF VARIANCE FOR HEURISTIC ELABORATION RATE
AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Main effects	3912.391	2	1956.196	3.927	0.026
Group	3912.391	2	1956.196	3.927	0.026
Explained	3912.391	2	1956.196	3.927	0.026
Residual	24908.477	50	498.170		
Total	28820.868	52	554.247		

53 cases were processed.

Table 7

ANALYSIS OF COVARIANCE FOR HEURISTIC ELABORATION RATE AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	352.668	1	352.668	0.691	0.410
SAT Verbal	352.668	1	352.668	0.691	0.410
Main effects	3606.445	2	1803.222	3.535	0.037
Group	3606.445	2	1803.223	3.535	0.037
Explained	3959.113	3	1319.704	2.587	0.064
Residual	23975.868	47	510.125		
Total	27934.980	50	558.700		

Covariate	Raw regression coefficient
SATV	0.036

53 cases were processed.
2 cases (3.8%) were missing.

Table 8

MULTIPLE CLASSIFICATION ANALYSIS FOR HEURISTIC ELABORATION RATE AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 80.02

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Group							
Aristotle	19	9.93				9.61	
Burke	17	-10.78				-10.63	
Tagmemic	15	-0.35				-0.12	
			0.37				0.36
Multiple R squared							.142
Multiple R							.376

Table 9

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON QUANTITY OF IDEAS WITHIN ARISTOTLE GROUP

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
Pretest	19	35.5789	12.959	2.973	-90.3684	47.321	10.856
Posttest		125.9474	46.741	10.723			
Adjusted Pretest	19	71.157	25.917	5.946	-54.7895	31.280	11.764
Posttest		125.9474	46.741	10.723			

	CORR.	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
table (cont.)	0.094	0.703	-8.32	18	0.000
	0.094	0.703	-4.66	18	0.000

Table 10

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON QUANTITY OF IDEAS WITHIN BURKE GROUP

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
Pretest	17	30.7647	19.842	4.812	-102.4118	57.724	14.000
Posttest		133.1765	54.985	13.336			
Adjusted Pretest	17	61.5294	39.683	9.625	-71.6471	66.543	16.139
Posttest		133.1765	54.985	13.336			

	CORR.	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
table (cont.)	0.039	0.882	-7.32	16	0.000
	0.039	0.882	-4.44	16	0.000

Table 11

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON QUANTITY OF IDEAS WITHIN TAGMEMIC GROUP

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
Pretest	17	27.2353	14.977	3.633	-80.4118	63.366	15.369
Posttest		107.6471	55.851	13.546			
Adjusted Pretest	17	54.4706	29.954	7.265	-53.1765	73.211	17.756
Posttest		107.6471	55.851	13.546			

table (cont.)

	CORR.	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
	-0.401	0.110	-5.23	16	0.000
	-0.401	0.110	-2.99	16	0.009

Table 12

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON QUANTITY OF IDEAS WITHIN CONTROL GROUP

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
Pretest	16	29.4375	12.011	3.003	-15.5625	15.196	3.799
Posttest		45.0000	17.154	4.289			
Adjusted Pretest	16	58.8750	24.022	6.005	13.8750	21.357	5.339
Posttest		45.0000	17.154	4.289			

	CORR.	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
table (cont.)	0.504	0.047	-4.10	15	0.001
	0.504	0.047	2.60	15	0.020*

*Represents a significant decrease.

Table 13

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS WITHIN EACH GROUP

GROUP	VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
	Pretest		5.5263	2.195	0.504			
Aristotle		19				-4.6842	2.583	0.593
	Posttest		10.2105	2.299	0.527			
	Pretest		4.6471	1.766	0.428			
Burke		17				-4.4118	2.830	0.686
	Posttest		9.0588	2.277	0.552			
	Pretest		4.4118	1.583	0.384			
Tagmemic		17				-4.8471	3.408	0.827
	Posttest		9.0588	2.384	0.578			
	Pretest		4.5625	1.672	0.418			
Control		16				-1.3750	1.893	0.473
	Posttest		5.9375	1.879	0.470			

table (cont.)

	CORR.	2-WAY PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
Aristotle...	0.340	0.154	-7.90	18	0.000
Burke...	0.037	0.889	-6.43	16	0.000
Tagmemic...	-0.454	0.067	-5.62	16	0.000
Control...	0.436	0.091	-2.91	15	0.011

Table 14

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON COMPREHENSIVENESS WITHIN EACH GROUP

GROUP	VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
	Pretest		6.0526	2.147	0.492			
Aristotle		19				-3.8947	3.398	0.779
	Posttest		9.9474	2.697	0.619			
	Pretest		5.1765	2.069	0.502			
Burke		17				-3.3529	3.220	0.781
	Posttest		8.5294	2.503	0.607			
	Pretest		4.3529	1.693	0.411			
Tugmemic		17				-4.0588	3.631	0.881
	Posttest		8.4...3	2.599	0.630			
	Pretest		5.3750	2.217	0.554			
Control		16				-0.9375	2.645	0.661
	Posttest		6.3125	2.549	0.637			

table (cont.)

	CORR.	2-WAY PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
Aristotle...	0.029	0.905	-5.00	18	0.000
Burke...	0.017	0.948	-4.29	16	0.001
Tugmemic...	-0.404	0.108	-4.61	16	0.000
Control...	0.391	0.135	-1.42	15	0.177

Table 15

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON EVIDENCE OF INTELLECTUAL PROCESSING WITHIN EACH GROUP

GROUP	VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
	Pretest		5.8947	1.792	0.411			
Aristotle		19				-4.4737	2.220	0.509
	Posttest		10.3684	2.432	0.558			
	Pretest		5.5000	1.414	0.354			
Burke		16				-1.0625	2.016	0.504
	Posttest		6.5625	2.128	0.532			
	Pretest		5.4118	1.770	0.429			
Tagmemic		17				-3.7059	2.443	0.593
	Posttest		9.1176	2.118	0.514			
	Pretest		4.4706	1.663	0.403			
Control		17				-5.4706	3.448	0.836
	Posttest		9.9412	2.461	0.597			

		CORR.	2-WAY PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
	Aristotle...	0.481	0.037	-8.78	18	0.000
table (cont.)	Burke...	0.220	0.397	-6.25	16	0.000
	Tagmemic...	-0.375	0.139	-6.54	16	0.000
	Control...	0.410	0.115	-2.11	15	0.052

Table 16

RESULTS OF TWO-TAILED T-TEST FOR CORRELATED SAMPLES ON OVERALL QUALITY WITHIN EACH GROUP

GROUP	VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR
	Pretest		5.5263	1.806	0.414			
Aristotle		19				-4.5789	2.545	0.584
	Posttest		10.1053	2.492	0.572			
	Pretest		4.7059	1.896	0.460			
Burke		17				-3.7647	3.011	0.730
	Posttest		8.4706	2.478	0.601			
	Pretest		4.3529	1.618	0.392			
Tagmemic		17				-4.7059	3.771	0.915
	Posttest		9.0588	2.703	0.656			
	Pretest		4.7500	1.949	0.487			
Control		16				-1.2500	2.352	0.588
	Posttest		6.0000	2.000	0.500			

table (cont.)		CORR.	2-WAY PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
	Aristotle...	0.333	0.164	-7.84	18	0.000
	Burke...	0.071	0.786	-5.16	16	0.000
	Tagmemic...	-0.491	0.045	-5.15	16	0.000
	Control...	0.291	0.275	-2.13	15	0.051

Table 17

ANALYSIS OF COVARIANCE FOR HEURISTIC INTERNALIZATION
AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	2.391	2	1.195	1.569	0.221
SATV	0.877	1	0.877	1.151	0.290
ECT	2.388	1	2.388	3.136	0.085
Main effects	2.715	2	1.358	1.783	0.182
Groups	2.715	2	1.358	1.783	0.182
Explained	5.106	4	1.276	1.676	0.176
Residual	28.941	38	0.762		
Total	34.047	42	0.811		

45 cases were processed
18 cases (19.9%) were missing.

Table 18

MULTIPLE CLASSIFICATION ANALYSIS FOR HEURISTIC INTERNALIZATION
AMONG THREE EXPERIMENTAL GROUPS

Grand mean = #.#&

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	16	0.32				0.29	
Burke	15	-0.04				-0.03	
Tagmemic	12	-0.37				-0.36	
			0.31				0.29
Multiple R squared							.150
Multiple R							.387

Table 19

ANALYSIS OF COVARIANCE FOR PRETEST QUANTITY OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	1549.010	2	774.505	3.583	0.034
SATV	121.033	1	121.033	0.560	0.457
ECT	430.028	1	430.028	1.990	0.164
Main effects	680.898	3	226.966	1.050	0.378
Groups	680.898	3	226.966	1.050	0.378
Explained	2229.908	5	445.982	2.063	0.084
Residual	11887.863	55	216.143		
Total	14117.771	60	235.296		

69 cases were processed
8 cases (11.6%) were missing.

Table 20

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST QUANTITY OF IDEAS

Grand mean = 30.34

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	5.38				4.87	
Burke	15	-2.28				-0.72	
Tagmemic	14	-3.27				-1.57	
Control	14	-1.20				-3.92	
			0.23				0.22
Multiple R squared							.158
Multiple R							.397

Table 21

ANALYSIS OF COVARIANCE FOR POSTTEST QUANTITY OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	3345.395	2	1672.698	0.952	0.392
SATV	2811.602	1	2811.692	1.600	0.211
ECT	334.314	1	334.314	0.190	0.664
Main effects	65013.023	3	21671.008	12.334	0.000
Groups	65013.023	3	21671.008	12.334	0.000
Explained	68358.419	5	13671.684	7.781	0.000
Residual	96639.024	55	1757.073		
Total	164997.443	60	2749.957		

69 cases were processed.
8 cases (11.6%) were missing.

Table 22

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST QUANTITY OF IDEAS

Grand mean = 98.67

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	18	21.55				21.68	
Burke	15	26.39				27.63	
Tagmemic	14	0.90				2.18	
Control	14	-56.89				-59.66	
			0.62				0.65
Multiple R squared							.414
Multiple R							.644

Table 23

ANALYSIS OF COVARIANCE FOR PRETEST QUANTITY OF IDEAS
AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	1212.504	1	1212.504	4.890	0.032
SATV	1212.504	1	1212.504	4.890	0.032
Main effects	498.770	2	249.385	1.006	0.373
Groups	498.770	2	249.385	1.006	0.373
Explained	1711.274	3	570.425	2.301	0.089
Residual	11652.766	47	247.931		
Total	13364.039	50	267.281		

Covariate	Raw regression coefficient
SATV	0.067

53 cases were processed.
2 cases (3.8%) were missing.

Table 24

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST QUANTITY OF IDEAS
AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 31.20

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	19	4.38				3.43	
Burke	17	-0.43				0.03	
Tagmemic	15	-5.06				-4.38	
			0.24				0.20
Multiple R squared							.128
Multiple R							.358

Table 25

ANALYSIS OF COVARIANCE FOR POSTTEST QUANTITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	57.709	1	57.709	0.020	0.889
SATV	57.709	1	57.709	0.020	0.889
Main effects	4702.555	2	2351.278	0.805	0.453
Groups	4702.555	2	2351.278	0.805	0.453
Explained	4760.264	3	1586.755	0.544	0.655
Residual	137198.365	47	2919.114		
Total	141958.629	50	2839.173		

Covariate	Raw regression coefficient
SATV	0.015

53 cases were processed.
2 cases (3.8%) were missing.

Table 26

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST QUANTITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 123.45

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	19	2.50				2.37	
Burke	17	9.73				9.79	
Tagmemic	15	-14.18				-14.10	
			0.18				0.18
Multiple R squared							.034
Multiple R							.183

Table 27

ANALYSIS OF COVARIANCE FOR PRETEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	11.743	2	5.871	1.812	0.173
SATV	0.960	1	0.960	0.296	0.589
ECT	3.191	1	3.191	0.985	0.325
Main effects	14.740	3	4.913	1.516	0.220
Groups	14.740	3	4.913	1.516	0.220
Explained	26.483	5	5.297	1.635	0.166
Residual	178.206	55	3.240		
Total	204.689	60	3.411		

69 cases were processed
8 cases (11.6%) were missing.

Table 28

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS OF IDEAS

Grand mean = 4.70

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	18	0.80				0.75	
Burke	15	-0.37				-0.24	
Tagmemic	14	-0.42				-0.28	
Control	14	-0.20				-0.43	
			0.28				0.27
Multiple R squared							.129
Multiple R							.360

Table 29

ANALYSIS OF COVARIANCE FOR POSTTEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	5.239	2	2.620	0.567	0.570
SATV	0.331	1	0.331	0.072	0.790
ECT	1.594	1	1.594	0.345	0.559
Main effects	182.083	3	60.694	13.148	0.000
Groups	182.083	3	60.694	13.148	0.000
Explained	187.322	5	37.464	8.116	0.000
Residual	253.891	55	4.616		
Total	441.213	60	7.354		

69 cases were processed.
8 cases (11.6%) were missing.

Table 30

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS OF IDEAS

Grand mean = 8.48

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	1.69				1.63	
Burke	15	0.26				0.47	
Tagmemic	14	0.31				0.54	
Control	14	-2.76				-3.13	
			0.60				0.66
Multiple R squared							.425
Multiple R							.652

Table 31

ANALYSIS OF COVARIANCE FOR PRETEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	19.495	1	19.495	6.171	0.017
SATV	19.495	1	19.495	6.171	0.017
Main effects	10.784	2	5.392	1.707	0.192
Groups	10.784	2	5.392	1.707	0.192
Explained	30.279	3	10.093	3.195	0.032
Residual	148.466	47	3.159		
Total	178.745	50	3.575		

Covariate	Raw regression coefficient
SATV	0.009

53 cases were processed.
2 cases (3.8%) were missing.

Table 32

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 4.84

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.68				0.57	
Burke	17	-0.20				-0.14	
Tagmemic	15	-0.64				-0.56	
			0.30				0.25
Multiple R squared							.169
Multiple R							.412

Table 33

ANALYSIS OF COVARIANCE FOR POSTTEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	18.987	1	18.987	3.500	0.068
SATV	18.987	1	18.987	3.500	0.068
Main effects	10.770	2	5.385	0.993	0.378
Groups	10.770	2	5.385	0.993	0.378
Explained	29.757	3	9.919	1.828	0.155
Residual	254.988	47	5.425		
Total	284.745	50	5.695		

Covariate	Raw regression coefficient
SATV	0.008

53 cases were processed.
2 cases (3.8%) were missing.

Table 34

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST FACTUALITY, SURPRISE VALUE, AND INSIGHTFULNESS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 9.49

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	19	0.72				0.60	
Burke	17	-0.43				-0.38	
Tagmemic	15	-0.42				-0.34	
			0.23				0.20
Multiple R squared							.105
Multiple R							.323

Table 35

ANALYSIS OF COVARIANCE FOR PRETEST COMPREHENSIVENESS OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	15.288	2	7.644	1.878	0.163
SATV	1.135	1	1.135	0.279	0.600
ECT	4.345	1	4.345	1.068	0.306
Main effects	20.526	3	6.842	1.681	0.182
Groups	20.526	3	6.842	1.681	0.182
Explained	35.814	5	7.163	1.760	0.137
Residual	223.858	55	4.070		
Total	259.672	60	4.328		

69 cases were processed.
8 cases (11.6%) were missing.

Table 36

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST COMPREHENSIVENESS OF IDEAS

Grand mean = 5.15

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	0.80				0.76	
Burke	15	-0.21				-0.09	
Tagmemic	14	-1.00				-0.87	
Control	14	0.21				0.00	
			0.32				0.28
Multiple R squared							.138
Multiple R							.371

Table 37

ANALYSIS OF COVARIANCE FOR POSTTEST COMPREHENSIVENESS OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif: of F
Covariates	9.944	2	4.972	0.832	0.441
SATV	0.361	1	0.361	0.060	0.807
ECT	7.309	1	7.309	1.223	0.274
Main effects	135.632	3	45.211	7.563	0.000
Groups	135.632	3	45.211	7.563	0.000
Explained	145.576	5	29.115	4.870	0.001
Residual	328.785	55	5.978		
Total	474.361	60	7.906		

69 cases were processed.
8 cases (11.6%) were missing.

Table 38

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST COMPREHENSIVENESS OF IDEAS

Grand mean = 8.16

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	1.72				1.68	
Burke	15	0.04				0.23	
Tagmemic	14	-0.09				0.12	
Control	14	-2.16				-2.52	
			0.50				0.54
Multiple R squared							.307
Multiple R							.554

Table 39

ANALYSIS OF COVARIANCE FOR PRETEST COMPREHENSIVENESS OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	16.551	1	16.551	4.424	0.041
SATV	16.551	1	16.551	4.424	0.041
Main effects	27.035	2	13.517	3.613	0.035
Groups	27.035	2	13.517	3.613	0.035
Explained	43.585	3	14.528	3.884	0.015
Residual	175.827	47	3.741		
Total	219.412	50	4.388		

Covariate	Raw regression coefficient
SATV	0.008

53 cases were processed.
2 cases (3.8%) were missing.

Table 40

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST COMPREHENSIVENESS OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 5.18

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.88				0.78	
Burke	17	0.00				0.05	
Tagmemic	15	-1.11				-1.04	
			0.39				0.35
Multiple R squared							.199
Multiple R							.446

Table 41

ANALYSIS OF COVARIANCE FOR POSTTEST COMPREHENSIVENESS OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	21.951	1	21.951	3.207	0.080
SATV	21.951	1	21.951	3.207	0.080
Main effects	18.267	2	9.134	1.334	0.273
Groups	18.267	2	9.134	1.334	0.273
Explained	40.219	3	13.406	1.959	0.133
Residual	321.703	47	6.845		
Total	361.922	50	7.238		

Covariate	Raw regression coefficient
SATV	0.009

53 cases were processed.
2 cases (3.8%) were missing.

Table 42

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST COMPREHENSIVENESS OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 9.04

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.91				0.79	
Burke	17	-0.51				-0.45	
Tagmemic	15	-0.57				-0.49	
			0.26				0.23
Multiple R squared							.111
Multiple R							.333

Table 43

ANALYSIS OF COVARIANCE FOR PRETEST EVIDENCE OF INTELLECTUAL PROCESSING

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	25.398	2	12.699	5.293	0.008
SATV	13.588	1	13.588	5.664	0.021
ECT	0.008	1	0.008	0.003	0.954
Main effects	11.966	3	3.989	1.663	0.186
Groups	11.966	3	3.989	1.663	0.186
Explained	37.364	5	7.473	3.115	0.015
Residual	131.948	55	2.399		
Total	169.311	60	2.822		

69 cases were processed.
8 cases (11.6%) were missing.

Table 44

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST EVIDENCE OF INTELLECTUAL PROCESSING

Grand mean = 5.25

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	0.59				0.52	
Burke	15	-0.11				0.03	
Tagmemic	14	-0.89				-0.73	
Control	14	0.25				0.03	
			0.33				0.27
Multiple R squared							.221
Multiple R							.470

Table 45

ANALYSIS OF COVARIANCE FOR POSTTEST EVIDENCE OF INTELLECTUAL PROCESSING

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	5.924	2	2.962	0.708	0.497
SATV	0.067	1	0.067	0.016	0.899
ECT	2.643	1	2.643	0.632	0.430
Main effects	167.310	3	55.770	13.332	0.000
Groups	167.310	3	55.770	13.332	0.000
Explained	173.234	5	34.647	8.282	0.000
Residual	230.078	55	4.183		
Total	403.311	60	6.722		

69 cases were processed.
8 cases (11.6%) were missing.

Table 46

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST EVIDENCE OF INTELLECTUAL PROCESSING

Grand mean = 8.75

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	18	1.52				1.46	
Burke	15	-0.09				0.12	
Tagmemic	14	0.75				0.98	
Control	14	-2.61				-2.99	
			0.60				0.66
Multiple R squared							.430
Multiple R							.655

Table 47

ANALYSIS OF COVARIANCE FOR PRETEST EVIDENCE OF INTELLECTUAL PROCESSING AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	26.900	1	26.900	10.742	0.002
SATV	26.900	1	26.900	10.742	0.002
Main effects	17.085	2	8.543	3.411	0.041
Groups	17.085	2	8.543	3.411	0.041
Explained	43.985	3	14.662	5.855	0.002
Residual	117.701	47	2.504		
Total	161.686	50	3.234		

Covariate	Raw regression coefficient
SATV	0.010

53 cases were processed.
2 cases (3.8%) were missing.

Table 48

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST EVIDENCE OF INTELLECTUAL PROCESSING AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 5.25

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.64				0.50	
Burke	17	0.16				0.23	
Tagmemic	15	-0.99				-0.89	
			0.38				0.33
Multiple R squared							.272
Multiple R							.522

Table 49

ANALYSIS OF COVARIANCE FOR POSTTEST EVIDENCE OF INTELLECTUAL PROCESSING AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	22.132	1	22.132	4.122	0.048
SATV	22.132	1	22.132	4.122	0.048
Main effects	10.107	2	5.053	0.941	0.397
Groups	10.107	2	5.053	0.941	0.397
Explained	32.239	3	10.746	2.001	0.127
Residual	252.388	47	5.370		
Total	284.627	50	5.693		

Covariate	Raw regression coefficient
SATV	0.009

53 cases were processed.
2 cases (3.8%) were missing.

Table 50

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST EVIDENCE OF INTELLECTUAL PROCESSING AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 9.78

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.58				0.45	
Burke	17	-0.67				-0.60	
Tagmemic	15	0.02				0.11	
			0.22				0.19
Multiple R squared							.113
Multiple R							.337

Table 51

ANALYSIS OF COVARIANCE FOR PRETEST OVERALL QUALITY OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	15.060	2	7.530	2.414	0.099
SATV	4.017	1	4.017	1.288	0.261
ECT	1.277	1	1.277	0.409	0.525
Main effects	11.616	3	3.872	1.241	0.304
Groups	11.616	3	3.872	1.241	0.304
Explained	26.676	5	5.335	1.710	0.148
Residual	171.553	55	3.119		
Total	198.230	60	3.304		

69 cases were processed.
8 cases (11.6%) were missing.

Table 52

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST OVERALL QUALITY OF IDEAS

Grand mean = 4.79

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	18	0.71				0.66	
Burke	15	-0.39				-0.26	
Tagmemic	14	-0.57				-0.43	
Control	14	0.07				-0.14	
			0.28				0.24
Multiple R squared							.135
Multiple R							.367

Table 53

ANALYSIS OF COVARIANCE FOR POSTTEST OVERALL QUALITY OF IDEAS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	8.746	2	4.373	0.851	0.433
SATV	0.163	1	0.163	0.032	0.859
ECT	3.642	1	3.642	0.708	0.404
Main effects	164.352	3	54.784	10.658	0.000
Groups	164.352	3	54.784	10.658	0.000
Explained	173.098	5	34.620	6.735	0.000
Residual	282.705	55	5.140		
Total	455.803	60	7.597		

69 cases were processed.
8 cases (11.6%) were missing.

Table 54

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST OVERALL QUALITY OF IDEAS

Grand mean = 8.26

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	18	1.74				1.68	
Burke	15	-0.20				0.02	
Tagmemic	14	0.45				0.69	
Control	14	-2.48				-2.87	
			0.56				0.61
Multiple R squared							.380
Multiple R							.616

Table 55

ANALYSIS OF COVARIANCE FOR PRETEST OVERALL QUALITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	22.497	1	22.497	8.335	0.006
SATV	22.497	1	22.497	8.335	0.006
Main effects	11.390	2	5.695	2.110	0.133
Groups	11.390	2	5.695	2.110	0.133
Explained	33.887	3	11.296	4.185	0.010
Residual	126.858	47	2.699		
Total	160.745	50	3.215		

Covariate	Raw regression coefficient
SATV	0.009

53 cases were processed.
2 cases (3.8%) were missing.

Table 56

MULTIPLE CLASSIFICATION ANALYSIS FOR PRETEST OVERALL QUALITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 4.84

Variable + category	N	Unadjusted Dev'n	Eta	Adjusted for independents Dev'n	Beta	Adjusted for independents + covariates Dev'n	Beta
Groups							
Aristotle	19	0.68				0.56	
Burke	17	-0.14				-0.08	
Tagmemic	15	-0.71				-0.62	
			0.32				0.27

Multiple R squared	.211
Multiple R	.459

Table 57

ANALYSIS OF COVARIANCE FOR POSTTEST OVERALL QUALITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Source of variation	Sum of Squares	df	Mean Square	F	Signif. of F
Covariates	21.591	1	21.591	3.281	0.076
SATV	21.591	1	21.591	3.281	0.076
Main effects	18.764	2	9.382	1.426	0.251
Groups	18.764	2	9.382	1.426	0.251
Explained	40.356	3	13.452	2.044	0.121
Residual	309.330	47	6.581		
Total	349.686	50	6.994		

Covariate	Raw regression coefficient
SATV	0.009

53 cases were processed.
2 cases (3.8%) were missing.

Table 58

MULTIPLE CLASSIFICATION ANALYSIS FOR POSTTEST OVERALL QUALITY OF IDEAS AMONG THREE EXPERIMENTAL GROUPS

Grand mean = 9.25

Variable + category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for independents Dev'n	Adjusted for independents Beta	Adjusted for independents + covariates Dev'n	Adjusted for independents + covariates Beta
Groups							
Aristotle	19	0.85				0.73	
Burke	17	-0.78				-0.73	
Tagmemic	15	-0.19				-0.10	
			0.27				0.23
Multiple R squared							.115
Multiple R							.340

TABLE 59

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS

	SATV	ECT	ENGLISH GRADE	HIGH SCHOOL RANK
PRETEST QUANTITY	0.1641 (69) S= .178	0.0354 (69) S= .773	0.0033 (69) S= .978	-0.0223 (69) S= .855
POSTTEST QUANTITY	-0.0300 (69) S= .806	-0.2753 (69) S= .022	-0.0206 (69) S= .867	-0.1221 (69) S= .317
PRETEST INSIGHTFULNESS	0.0643 (69) S= .600	-0.0524 (69) S= .669	0.0649 (69) S= .596	-0.0159 (69) S= .89
POSTTEST INSIGHTFULNESS	0.0575 (69) S= .639	-0.1222 (69) S= .317	0.0699 (69) S= .568	-0.0539 (69) S= .660
PRETEST OVERALL QUALITY	0.1069 (69) S= .382	0.0010 (69) S= .994	0.1062 (69) S= .385	-0.0281 (69) S= .819
POSTTEST OVERALL QUALITY	0.0505 (69) S= .680	-0.1511 (69) S= .215	0.0718 (69) S= .558	-0.1091 (69) S= .372

(Coefficient / (Cases) / Significance)